WHEN THE RUST SETTLES, CONVERT IT

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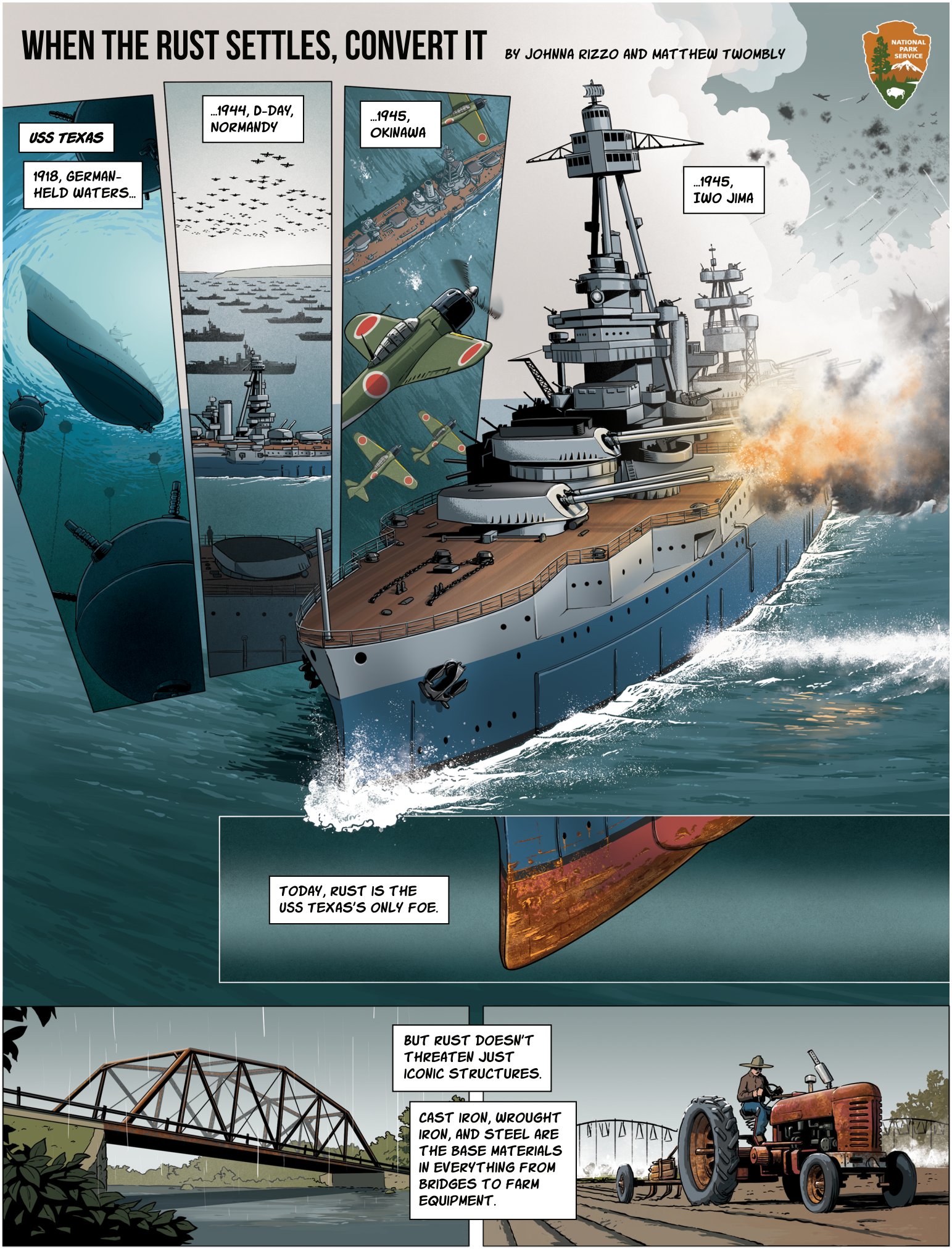

EXPOSED IRON WILL CORRODE IN AS LITTLE AS SIX MONTHS.

PAINT SHIELDS METAL FROM SALTY AIR, OXYGEN, AND MOISTURE—THE MAIN ENEMIES OF METAL OBJECTS.

SALTY AIR

OXYGEN (O_2)

MOISTURE

PAINT

BUT OVER TIME, ALL PAINT CRACKS. IT'S IN THESE LITTLE CREVICES THAT WATER CREEPS IN.

THE INEVITABLE END RESULT IS RUST.

THOUGH IT CAN'T BE PREVENTED, RUST ITSELF CAN BE TRANSFORMED IN A PROCESS CALLED RUST CONVERSION.

WHEN IRON (FE) IS MADE, IRON ORE IS HEATED TO TAKE THE OXYGEN (O_2) OUT AND ADD OTHER ELEMENTS LIKE CARBON (C) AND NICKEL IN TO MAKE IT STRONGER. THAT MAKES IRON ALWAYS IN SEARCH OF ITS LOST OXYGEN.

C

IRON ORE

O_2

DURING THE RUSTING PROCESS, THE ELECTRONS IN THE ADDED ELEMENTS GET SOAKED UP BY SEAWATER, RAIN, AND HUMIDITY.

H_2O

OXYGEN IN AIR DONATES ITS ELECTRONS TO THE IRON.

IRON MOVES OUTWARD AND THE OXYGEN MOVES INWARD.

FE

O_2

FE

ALL THAT MOVING AROUND FORMS PITS AND THE SURFACE BECOMES FLAKY AND LOOSE.

PITS CAN DISINTEGRATE INTO HOLES THAT CREATE MORE PLACES FOR OXYGEN TO SNEAK IN.

O_2

Fe_2O_3

THE BONDING IRON AND OXYGEN ABSORBS LIGHT ENERGY AND REFLECTS IT BACK. THIS GIVES THE NEWLY CREATED IRON OXIDE (FE_2O_3), COMMONLY CALLED RUST, ITS REDDISH COLOR.

SANDBLASTING BREAKS AWAY BITS OF IRON AND CREATES AN UNEVEN SURFACE WITH EVEN MORE NOOKS FOR THE OXYGEN TO GRAB IRON.

RUST CONVERTERS, ON THE OTHER HAND, TURN THE RUST INTO SOMETHING ELSE.

THEY INTRODUCE TANNIC ACID, WHICH CATALYZES A REACTION WITH THE IRON OXIDE.

TANNIC ACID

Fe_2O_3

H

H_2O

O_2

Fe_2O_3

THE TANNIC ACID'S HYDROGEN (H) GRABS THE OXYGEN FROM THE RUST, MAKING WATER (H_2O), WHICH EVENTUALLY EVAPORATES.

FE FE FE FE FE TANNATE

WHEN THE HYDROGEN GOES AWAY, IT LEAVES BEHIND VERY LARGE MOLECULES CALLED TANNATES THAT WRAP AROUND THE IRON MOLECULES. THIS BOND FORMS AN IRON TANNATE.

THE OXYGEN CAN'T GRAB ANY MORE IRON BECAUSE THE TANNATES ARE ALREADY STUCK TO IT, ACTING AS A SHIELD.

O_2

RUST CONVERSION CREATES A STABLE SURFACE THAT CAN BE PAINTED, SAVING THE IRON FOR ANOTHER DAY.

NCPTT

SOURCE: NATIONAL CENTER FOR PRESERVATION TECHNOLOGY AND TRAINING, NATIONAL PARK SERVICE.